SEX WORKERS

Influence of age and geographical origin in the prevalence of high risk human papillomavirus in migrant female sex workers in Spain

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Objectives: To estimate the prevalence and risk factors of high risk human papillomavirus (HPV) infection in migrant female sex workers (FSW) according to age and geographical origin.
Methods: Cross sectional study of migrant FSW attending a sexually transmitted infection (STI) clinic in Madrid during 2002. Information on sociodemographic characteristics, reproductive and sexual health, smoking, time in commercial sex work, history of STIs, HIV, hepatitis B, hepatitis C, syphilis, and genitourinary infections was collected. High risk HPV Infection was determined through the Digene HPV Test, Hybrid Capture II. Data were analysed through multiple logistic regression.
Results: 734 women were studied. Overall HPV prevalence was 39%; 61% in eastern Europeans, 42% in Ecuadorians, 39% in Colombians, 29% in sub-Saharan Africans, and 24% in Caribbeans (p = 0.057). HPV prevalence showed a decreasing trend by age; 49% under 20 years, 35% in 21–25 years,14% over 36 years% (p<0.005). In multivariate analyses, area of origin (p = 0.07), hormonal contraception in women not using condoms (OR 19.45 95% CI: 2.45 to 154.27), smoking, age, and an interaction between these last two variables (p = 0.039) had statistically significant associations with HPV prevalence. STI prevalence was 11% and was not related to age or geographical origin.
Conclusions: High risk HPV prevalence in migrant FSW is elevated and related to age, area of origin, and use of oral contraceptives in women not using condoms. These data support the role of acquired immunity in the epidemiology of HPV infection and identifies migrant FSW as a priority group for sexual health promotion.

Human papillomavirus infection (HPV) is the commonest sexually transmitted infection (STI) worldwide. More than 20 types of papillomavirus have been associated with cervical cancer, the second cause of cancer related mortality in women globally.[1–3] Most HPV infections are asymptomatic and resolve spontaneously with cervical smear abnormalities only occurring in those women with persistent HPV infection.[4][5] The advent of molecular biology tools in HPV diagnosis has allowed us to identify HPV infection, differentiate HPV types, and discriminate groups of the population with different risks of infection.[2]

HPV prevalence depends largely on age and on sexual practices.[6–8] The prevalence of high risk HPV ranges from 11% in healthy women in Belgium,[9] 20% in female university students in the United States[10] to 36% in Italian women at risk for human immunodeficiency virus (HIV) infection[11] and 46% in Spanish women in prisons.[12] The highest prevalences of HPV have been described in female sex workers (FSWs) as they have multiple risk factors for HPV infection, such as young age and multiple sexual contacts.[13–16] There is wide heterogeneity in reported HPV prevalences in FSW from studies in different geographical areas; 43% in Mexico,[14] 48% in Japan,[15] and 63% in Calcutta, India.[16]

Over the last few years, an increasing proportion of the FSWs in European countries are migrants.[17] This phenomenon has also occurred in Spain, where a very large proportion of these women originate from other countries, the majority from South America.[18–20] It is likely that migrant FSWs differ from other groups of the population in terms of sociodemographic characteristics, sexual and health seeking behaviour, as well as HPV prevalence and types. The knowledge of these characteristics is essential to design appropriate preventive and curative strategies.

The objective of this work is to estimate the prevalence of high risk HPV infection in migrant FSW attending the largest STI clinic in Madrid during 2002 according to their age and geographical origin, and identify risk factors associated with it.

SUBJECTS AND METHODS

Cross sectional study of all migrant female sex workers who attended "Centro Sanitario Sandoval," the largest STI clinic in Madrid, from January to September 2002. The Centro Sanitario Sandoval is an ambulatory STI clinic and HIV screening centre whose access is open, free, and anonymous and which has been a pioneering centre in STDs and HIV prevention in Spain. Information on sociodemographic characteristics (age, country of birth, marital status) reproductive health (number of pregnancies, children, termination of pregnancies (TOP), type of contraceptives (hormonal or not) and barriers methods used, smoking habits, time in commercial sex work, reasons for attending the clinic, past history of STI and/or genitourinary infections (GUI) was collected. Full gynaecological examinations were conducted and all women had cervical and vaginal swabs and vaginal fresh specimens to test for STIs (gonorrhoea, *Chlamydia trachomatis*, *Trichomonas vaginalis*) and/or other genitourinary

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Abbreviations: FSW female sex workers, ; HC, hormonal contraception; HPV, human papillomavirus; IUD, intrauterine device; TL, tubal ligation; TOP, termination of pregnancy

infections (bacterial vaginosis and vaginal candidiasis). Serological tests for hepatitis B infection (HBsAg, HBcAb), hepatitis C (HCV), and syphilis (RPR, TPHA) were also carried out. HIV test with informed consent was requested.

High risk HPV infection was determined through Digene HPV Test, Hybrid Capture II which identified types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, and 68. All cervical swabs were taken and placed in a tube containing Digene specimen transport medium (1 ml) and stored at −20°C until required for testing. HC2 HPV DNA test was performed in all samples using the high risk HPV probe mixture only, to minimise cost of testing. The exfoliated cells are first treated with alkali denaturing reagent and the processed samples are hybridised under high stringency conditions. Positive specimens are detected by binding the hybridisation complexes onto the surface of microplate well coated with monoclonal antibodies specific to RNA-DNA hybrids. Immobilised hybrids are detected by the addition of an alkaline phosphatase conjugated antibody to RNA-DNA hybrids, followed by the addition of a chemiluminescent substrate.

Statistical analyses

Data analysis was performed on microcomputer using Stata vs 6 software. The univariate analysis of demographic and clinical differences were analysed using the two sample t test for normally distributed continuous data, the Mann-Whitney test for non-parametric data, the χ^2 test for frequencies, and Fisher's test and the χ^2 test for trend. Multiple logistic regression modelling was used for the analysis of associations between variables where some were considered possible confounders after checking for interactions.

RESULTS
Sociodemographic characteristics

In all, 734 women were included in the study; 397 (54%) originated from Colombia, 158 (22%) from Ecuador, 70 (10%) from the Caribbean, 25 (3%) from other Latin American countries, 24 (3%) from sub-Saharan Africa, 18 (2%) from eastern Europe, and 42 (6%) from other countries (table 1). Median age was 27 years (range 16–50) with variations seen according to country of origin; the youngest women were from eastern Europe whose median age was 22 years (table 1).

Most women were single and this pattern was similar across all countries of origin. Over half of these women, 395 (54%), had one or more children though marked differences were seen according to areas of origin; while this proportion was around 50% for Latin American countries, it was below 25% for FSW originating from eastern Europe and sub-Saharan Africa. Of those women with data on terminations of pregnancies (TOPs), 274 (38%) had had at least one TOP in their lifetime; 33% of the Colombians, 43% of the Ecuadorians, 28% of the eastern Europeans, and 51% of the Caribbeans (table 1). A high proportion of the women used condoms as contraceptive methods, either alone (60% of the women) or in combination with hormonal contraceptives (27%) or with mechanical methods (9%) (table 1).

Median time of sex work was 0.7 years although this information was only available in 60% of the women (table 1). The women from the Caribbean and sub-Saharan Africa had been working in commercial sex for longer periods of time (median times of 1 year respectively) compared to women from Colombia and eastern Europe (median times of

Table 1 Sociodemographic and reproductive characteristics of migrant FSWs according to geographical origin

Variables	Total No (%) 734 (100)	Colombia No (%) 397 (54)	Ecuador No (%) 158 (22)	Caribbean No (%) 70 (10)	Latin America No (%) 25 (3)	Sub-Saharan Africa No (%) 24 (3)	Eastern Europe No (%) 18 (2)	Others No (%) 42 (6)
Age (years)								
<20	83 (11)	45 (11)	20 (13)	6 (9)	1 (4)	2 (8)	4 (22)	5 (12)
21–25	214 (29)	106 (27)	49 (31)	23 (33)	9 (36)	10 (42)	9 (50)	8 (19)
26–30	180 (25)	102 (26)	41 (26)	12 (17)	6 (24)	5 (21)	4 (22)	10 (24)
31–35	180 (25)	100 (25)	38 (24)	19 (27)	4 (16)	6 (25)	1 (6)	12 (28)
>36	76 (10)	43 (11)	10 (6)	10 (14)	5 (20)	1 (4)	0 (0)	7 (17)
No of children								
0	339 (46)	177 (45)	60 (38)	35 (50)	12 (48)	18 (75)	16 (89)	21 (50)
1	215 (29)	119 (30)	50 (32)	18 (26)	8 (32)	5 (21)	2 (11)	13 (31)
>1	180 (25)	101 (25)	48 (30)	17 (24)	5 (20)	1 (4)	0 (0)	8 (19)
No of TOPs								
0	312 (42)	194 (49)	61 (39)	23 (33)	9 (36)	4 (17)	6 (33)	15 (36)
1	182 (25)	98 (25)	45 (28)	20 (28)	5 (20)	3 (12)	3 (17)	8 (19)
>1	92 (13)	33 (8)	23 (15)	16 (23)	5 (20)	4 (17)	2 (11)	9 (21)
Unknown	148 (20)	72 (18)	29 (18)	11 (16)	6 (24)	13 (54)	7 (39)	10 (24)
Contraceptive method								
Condoms only	439 (60)	214 (54)	97 (61)	51 (73)	17 (68)	19 (79)	15 (83)	26 (62)
HC only	15 (2)	11 (3)	3 (2)	0	0	0	1 (6)	0
Condoms + HC	199 (27)	114 (29)	41 (26)	17 (24)	6 (24)	5 (21)	2 (11)	14 (33)
Condoms + IUD/TL	69 (9)	48 (12)	15 (10)	2 (3)	2 (8)	0	0	2 (5)
IUD/TL	12 (2)	10 (2)	2 (1)	0	0	0	0	0
Median years sex work	0.7	0.6	0.7	1	1	1	0.6	1
Smoking								
Yes	156 (21)	82 (21)	32 (20)	11 (16)	5 (20)	2 (8)	8 (44)	16 (38)
No	317 (43)	181 (45)	78 (49)	32 (46)	8 (32)	5 (21)	1 (6)	12 (29)
Unknown	261 (36)	134 (34)	48 (31)	27 (38)	12 (48)	17 (71)	9 (50)	14 (33)
Consultation								
Acute symptoms	435 (59)	232 (58)	99 (63)	46 (66)	15 (60)	14 (58)	9 (50)	20 (48)
Routine control	270 (37)	150 (38)	51 (32)	22 (31)	9 (36)	7 (29)	9 (50)	22 (52)
HIV test/condom break	29 (4)	15 (4)	8 (5)	2 (3)	1 (4)	3 (13)	0 (0)	0 (0)

TOP = termination of pregnancy; HC = hormonal contraception. IUD = intrauterine device; TL = tubal ligation.

Table 2 Prevalence of current STIs and genitourinary infections in migrant FSWs according to geographical origin

Variables	Total	Colombia	Ecuador	Caribbean	Latin America	Sub-Saharan Africa	Eastern Europe	Others
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
	734 (100)	397 (54)	158 (22)	70 (10)	25 (3)	24 (3)	18 (2)	42 (6)
Current acute STI*	84 (11)	46 (12)	19 (12)	10 (14)	0 (0)	4 (17)	2 (11)	3 (7)
High risk HPV	283 (39)	156 (39)	67 (42)	17 (24)	9 (36)	7 (29)	11 (61)	16 (38)
Bacterial vaginosis	195 (27)	99 (25)	43 (27)	16 (23)	5 (20)	14 (58)	3 (17)	15 (36)
Candida albicans	196 (27)	95 (24)	45 (28)	20 (29)	9 (36)	11 (46)	6 (33)	10 (24)
RPR	30 (4)	17 (4)	4 (3)	3 (4)	3 (12)	1 (4)	1 (6)	1 (2)
TPHA	82 (11)	40 (10)	23 (15)	9 (13)	1 (4)	2 (8)	2 (11)	5 (12)
HbcAc	57 (8)	19 (5)	6 (4)	14 (20)	1 (4)	8 (33)	5 (28)	4 (9)
HbsAg	2 (0.3)	1 (0.2)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
HCV	1 (0,1)	1 (0,2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
HIV	5 (0.7)	2 (0.5)	0 (0)	0 (0)	0 (0)	2 (8)	0 (0)	1 (2)

Current acute STIs* = gonorrhoea, *Chlamydia trachomatis*, *Trichomonas vaginalis*.

0.6 year respectively. Data on smoking were only available in 64% of the women of whom 156 (39%) did smoke (table 1).

A high proportion of women, 435 (59%), attended the STI clinic because of acute symptoms and 270 (37%) went for routine check ups (table 1). There were no marked differences in the reasons for visiting the clinic according to the area of origin.

Prevalence of HPV and other infections

Forty five women (6%) had a past self reported history of an STI, with differences according to the area of origin; 7% of the Colombians, 8% of the sub-Saharan Africans, none of the eastern Europeans and 13% of the Caribbeans. A higher number of women, 182 (25%), reported a past history of genitourinary infections; 25% of the Colombians, 25% of the sub-Saharan Africans, 27% of the eastern Europeans, and 37% of the Caribbeans.

Current STI prevalence was 11% and there were no statistically significant differences by geographical origin (table 2). Overall high risk HPV prevalence was 39%, with differences according to area of origin; the lowest HPV prevalence was seen in FSW from the Caribbean, 24%, and the highest in FSW from eastern Europe (61%) (table 2). In spite of small numbers, differences were of borderline statistical significance (p = 0.065).

Five women (0.7%) were HIV positive; two of these five women were Colombians and two were sub-Saharan Africans; HIV prevalence for FSW from Colombia was 0.5% and was 8% for FSW from Africa. There was only one case of HCV infection in a Colombian woman. Two women were HBsAg positive and 57 (8%) had HBCAb. Prevalence of HBCAb was higher in women from sub-Saharan Africa (33%), from eastern Europe (28%) and the Caribbean (20%). TPHA was positive in 82 (11%) of the women and RPR in 30 (4%) of them with heterogeneous variations according to country of origin (table 2).

Variables associated with the presence of high risk HPV infection and other acute STIs

In univariate analyses, area of origin, age, marital status, use of hormonal contraceptives in women who did not report using barrier methods, smoking, number of children and number of TOPs had statistically significant associations with HPV infection (table 3). Use of hormonal contraceptives in women who also reported using condoms was not associated with an increased risk of HPV infection.

The prevalence of HPV infection was higher in younger women and showed a downward trend with increasing age; for women under 20 years, HPV prevalence was 53%, 35% for those between 26 and 30 years, and 14% for those over

36 years (p for trend 0.000) (table 3). The risk of being infected by HPV was more than double (OR 2.3 95% CI: 1.7 to 3.2) in women over 25 years compared to under 25 years and this pattern was seen for all areas of origin although the magnitude of the association varied from 1.9 (95% CI:1.3 to 2.9) in Colombians and 1.8 (95% CI:1 to 3.5) in Ecuadorians to the large and imprecise estimate of 11 (95% CI:1.1 to 114.1) in sub-Saharan Africans and 13.3 (95% CI:1 to 169.6) in eastern Europeans.

Most of the variables identified as predictive of HPV infection in univariate analyses were confounded by age since multivariate analyses revealed that only age, area of origin, smoking, hormonal contraception in women who did not report using condoms, and the interaction between age and smoking were statistically associated with HPV infection (LR test for the interaction p 0.039). Risk of HPV infection was lower in smokers over 25 years (OR 0.33 95% CI: 0.17 to 0.63) compared to non-smokers over 25 years (baseline) but was higher in women under 25, smokers, non-smokers, and those with unknown smoking status (table 4). Hormonal contraception in women not using barrier methods was associated with an increased risk of HPV infection (OR 19.45 95% CI: 2.45 to 154.27) (table 4).

The variables identified as predictive of HPV infection were not associated with the presence of an acute STI (table 3). There were no significant differences by geographical origin; only women from sub-Saharan Africa had a non-statistically significant higher proportion of STIs (17%) compared to the mean (11%). Although women under 20 years had a slightly higher prevalence of STIs (16%), no trend was seen and differences were not statistically significant (table 3). The only variables which were associated with a higher risk of an acute STI univariately were having more than one child and having a concurrent genitourinary infection. A positive syphilis serology was also associated with a double risk of having an acute STI although differences were of borderline statistical significance (table 3). Multivariate analyses did not modify the results observed in univariate analyses (data not shown).

DISCUSSION

This study has found an high prevalence of HPV infection in migrant FSWs attending a large STI clinic in Madrid which was associated with age and geographical origin. The highest prevalence was observed in women under 20 years old, of whom half were infected, and a decreasing prevalence with age was observed. FSW from sub-Saharan Africa and the Caribbean had the lowest risks of HPV infection in univariate and multivariate analyses and women from eastern Europe had the highest risk, although differences were of borderline

Table 3 Univariate analyses and prevalence of HPV infection and acute STIs in migrant FSWs

Variables	HPV prevalence	OR (95% CI)	p Value	STI prevalence*	OR (95% CI)	p Value
Area of origin						
Colombia	39%	1.00	0.057	12%	1.00	0.860
Ecuador	42%	1.13 (0.78 to 1.65)		12%	1.04 (0.59 to 1.84)	
Sub-Saharan Africa	29%	0.64 (0.26 to 1.57)		17%	1.52 (0.49 to 4.66)	
Eastern Europe	61%	2.4 (0.92 to 6.39)		11%	0.95 (0.21 to 4.28)	
Caribbean	24%	0.5 (0.27 to 0.88)		14%	1.27 (0.61 to 2.65)	
Latin America (others)	36%	0.86 (0.37 to 2.01)		–	–	
Others/unknown	38%	0.95 (0.48 to 1.83)		7%	0.58 (0.17 to 1.97)	
Age (years)						
<20	53%	1.00	0.000	16%	1.00	0.377
21–25	49%	0.87 (0.52 to 1.45)		12%	0.71 (0.34 to 1.47)	
26–30	35%	0.48 (0.28 to 0.81)		8%	0.49 (0.22 to 1.08)	
31–35	33%	0.43 (0.25 to 0.73)		13%	0.83 (0.39 to 1.72)	
>36	14%	0.15 (0.07–0.32)		9%	0.54 (0.20 to 1.45)	
Marital status						
Single	43%	1.00	0.035	12%	1.00	0.950
Married	31%	0.61 (0.34 to 1.06)		13%	1.07 (0.48 to 2.38)	
Widow/separated	36%	0.74 (0.41 to 1.32)		9%	0.78 (0.29 to 2.05)	
Unknown	32%	0.62 (0.42 to 0.89)		11%	0.93 (0.54 to 1.62)	
No of children						
0	44%	1.00	0.005	12%	1.00	0.021
1	37%	0.73		7%	0.54 (0.29 to 1.01)	
>1	30%	0.54		16%	1.34 (0.79 to 2.24)	
No of TOPS						
0	40%	1.00	0.004	13%	1.00	0.663
1	33%	0.74		9%	0.66 (0.36 to 1.20	
>1	27%	0.54		10%	0.67 (0.27 to 1.67)	
Contraceptive method						
Condoms only	39%	1.00	0.000	13%	1.00	0.37
HC only	93%	22 (2.9 to 171.6)		–	–	
Condoms + HC	36%	0.9 (0.6 to 1.2)		10%	0.73 (0.43 to 1.26)	
Condoms + IUD/TL	35%	0.8 (0.5 to 1.4)		7%	0.52 (0.20 to 1.32)	
IUD/TL	42%	1.1 (0.3 to 3.65)		8%	0.59 (0.08 to 4.72)	
Time in sex work						
≤1 years	38%	1.00	0.56	14%	1.00	0.196
>1 years	31%	0.75 (0.46 to 1.22)		8%	0.55 (0.25 to 1.22)	
Unknown	42%	1.2 (0.86 to 1.62)		10%	0.71 (0.44 to 1.16)	
Smoking						
No	39%	1.00	0.020	9%	1.00	0.208
Yes	29%	0.64 (0.42 to 0.97)		14%	1.63 (0.90 to 2.94)	
Unknown	43%	1.15 (0.83 to 1.61)		13%	1.47 (0.85 to 2.44)	
Reason for consultation						
Acute symptoms	39%	1.00	0.937	11%	1.00	0.784
Routine control	38%	0.95 (0.69 to 1.29)		12%	1.15 (0.71 to 1.85)	
HIV test/condom broke	38%	0.95 (0.44 to 2–07)		14%	1.32 (0.44 to 3.96)	
Concurrent GUI			0.94			
No	38%	1.00		6%	1.00	0.00
Yes	39%	1.01 (0.74 to 1.38)		15%	2.75 (1.54 to 4.90)	
Concurrent STIs			0.73			
No	38%	1.00		–		
Yes	43%	1.22 (0.77 to 1.94)				
TPHA			0.53			
No	39%	1.00		11%	1.00	0.10
Yes	35%	0.86 (0.53 to 1.38)		17%	1.71 (0.92 to 3.20)	
RPR			0.07			
No	39%	1.00		11%	1.00	0.16
Yes	23%	0.47 (0.20 to 1.11)		20%	2.00 (2.79 to 5.96)	

TOPs = termination of pregnancy; HC = hormonal contraception; IUD = intrauterine device; TL = tubal ligation; GUI = genitourinary infection.
*STI: gonorrhoea, *Chlamydia trachomatis*, *Trichomonas vaginalis*.

statistical significance. This study has also identified an increased risk of HPV infection in women who had taken hormonal contraceptives and did not report using barrier methods, and a lower risk of HPV for smokers over 25 years old.

The increased prevalence of HPV infection in younger women and the decreasing trend with age was already reported in the mid-1980s[21] and has been described by many studies since then.[13 14 22 23] The inverse relation between age and HPV prevalence has been attributed to the development of acquired HPV immunity over time after HPV exposure.[13 22] In our study, this trend in the age pattern was seen in all groups irrespective of their geographical origin although with variations in its magnitude and precision owing to different sample sizes. However, although age confounded many of the

associations identified in univariate analyses (marital status, number of children, etc), multivariate analyses adjusting for age, smoking, and use of hormonal contraception in women not using condoms, still revealed borderline statistically significant differences in HPV prevalence by geographical origin.

The highest HPV prevalence was seen in FSWs from eastern Europe, who were also the youngest, and the lowest prevalences were observed in FSW from sub-Saharan Africa and the Caribbean. Although differences were of borderline statistical significance because of the small number of women in some groups and therefore decreased power, they were maintained in age adjusted analyses. Country of origin must, therefore, be reflecting differences in either past or current sexual behaviours, but unfortunately, no detailed

Table 4 Multivariate analyses of variables predicting increased risk of HPV infection stratified by age in migrant FSWs

Variables	OR (95%CI)	p Value
Area of origin		0.07
Colombia	1.00	
Ecuador	1.11 (0.76 to 1.65)	
Sub-Saharan Africa	0.52 (0.20 to 1.35)	
Eastern Europe	1.77 (0.63 to 4.97)	
Caribbean	0.47 (0.26 to 0.85)	
Latin America (others)	0.87 (0.37 to 2.07)	
Others/unknown	1.17 (0.59 to 2.33)	
Age (years) and smoking		0.000
<25, smoker	1.7 (0.94 to 3.1)	
<25, non-smoker	1.63 (1.02 to 2.59)	
<25, unknown*	2.28 (1.36 to 3.8)	
>25, smoker	0.33 (0.17 to 0.63)	
>25, non-smoker	1.00	
>25, unknown*	0.93 (0.59 to 1.47)	
Hormonal contraception only		0.05
Yes	19.45 (2.45 to 154.27)	
No	1.00	

*Unknown smoking status.
Variables associated with the presence of acute STIs.

data were available for all women. The fact that no differences by geographical origin were observed for acute STIs suggests that past exposure to HPV may be a determinant of current HPV epidemiology, in line with what is known of acquired immunity to HPV. Another explanation could be the different natural history and clearance rates of different HPV types,[24] in case that they were not homogeneously distributed by country of origin. Further research into the HPV types of this sample is currently being conducted.

There is strong evidence of unsafe sex in these women, as highlighted by the high prevalence of termination of pregnancies (over a third) and other STIs (11%), and it has been shown that unsafe sex takes place with the regular partner and not with clients.[25] Prevalence of acute STIs was neither related to age nor geographical origin and although differences did not reach statistically significance, prevalence of other STIs was highest among sub-Saharan FSWs and lowest among eastern Europeans. Time spent in commercial sex work and past history of STIs were not associated with HPV prevalence. These data are, nevertheless, sensitive; information on time spent in commercial sex work is often missing and past history of STIs is also susceptible to recall bias. It is likely that a certain random misclassification may

have taken place which could explain the lack of observed association.

The association between hormonal contraceptives and persistent HPV infection has been reported by a number of studies,[10 26–30] and long term hormonal contraceptive use has been recently suggested to be associated with cervical carcinoma in women infected by high risk HPV.[27 28] This association has been found for both long term use as well as in those women who ever used hormonal contraceptives.[29 30] In our study, data on duration of hormonal contraceptives were not available but since the effect was only found for those who did not report using barrier methods, it is likely that these women might also be at higher risk of multiple HPV exposures.

The majority of studies report smoking as a risk factor for HPV persistence and malignant transformation.[8 10] However, previous studies have found lower HPV infection rates in smokers.[5 31] We have found a lower risk of HPV infection in the subgroups of women over 25 years of age who smoked, but whether this association is spurious or caused by uncontrolled confounding is not clear since no dose-response effect was found (data not shown) and data on duration of smoking were poor.

This study shows that migrant FSWs are a priority group for sexual health promotion as evidenced by their high prevalence of HPV infection, acute STIs, positive syphilis serology, and termination of pregnancies. It has also confirmed the previously described decreasing prevalence with age and highlighted differences by geographical origin that merit further research into the epidemiology and the natural history of HPV infection in highly exposed and marginalised groups.

CONTRIBUTORS

JdA, AG, MJB, and JdR initiated this project; JB, PC, CG, and JL were responsible for data collection and data entry; MO, AG, BM, LM were responsible for laboratory work; JdA, FB, CG, and JL were responsible for statistical analyses; JdA and FB wrote the first draft of the paper; all authors were involved in the study design and commented interim drafts; all authors have reviewed the final manuscript.

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Key messages

- HPV prevalence in migrant FSW is high (39%), as is the proportion having had a termination of pregnancy (38%) and an acute STI (11%). HIV prevalence was 8% in FSW from sub-Saharan Africa and under 1% in the women from other geographical areas

- The decreasing HPV prevalence with increasing age was seen in migrant FSW irrespective of their geographical origin supporting the existence of acquired HPV immunity after HPV exposure

- The fact that no differences by geographical origin were observed for acute STIs suggests that past exposure to HPV may be a determinant of current HPV epidemiology, in line with what is known of acquired immunity to HPV

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